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ABSTRACT

The growth and development of library networks increased the need for more rapid interlibrary communication. This survey describes the history, costs and recent developments of various means of interlibrary communication. Extensive references are provided for each area. The communications systems discussed are: surveys, mail, telephone, facsimile, television and radio, and computers. The network concept is also considered. A discussion of the future of interlibrary communications covers the human element (users of the system), computer potential and communications links. (SG)

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EDUCOM

RESEARCH MEMORANDUM

Biomedical Communications Project

(2) SURVEY OF

INTERLIBRARY COMMUNICATIONS SYSTEMS

Report RM-369

(5) April 1967

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Preface

This report was prepared for the Biomedical Communications Project of EDUCOM. The assignment was to prepare a bibliographic essay on interlibrary communications, including descriptions of techniques and equipment. Both presently existing and planned installations were to be surveyed.

As far as this was possible, the assignment was carried out. We were somewhat handicapped by a lack of local library resources and had to depend on correspondence and interlibrary loans for most of the information obtained. Both U. S. mail and interlibrary loan procedures proved every bit as clumsy and slow as described in some of the reports cited below, and too much time was lost simply following up references which turned up during the search. The literature survey is by no means finished; when additional references are found they will be submitted to the project.

Library Literature provided the initial source for many citations: others were identified subsequently. Since national planning for libraries has so thoroughly embraced the network concept, including, of course, telecommunications links, it proved to be most difficult to "stick to the assignment." Should this paper be considered of sufficient value for publication, it will become necessary to expand it considerably to include these broader concepts. An outline of such an expanded paper is included.

Considerable help was obtained from the local office of the

Southern Bell System. It would have been virtually impossible to complete the assignment without using both their contacts with the Teletype Corporation personnel cited in the report as well as printed brochures from various manufacturers collected by this office.

All pertinent references have been included in the report; when they were not examined it is so stated. Probably a number of important sources were missed; this is most assuredly true for the report literature which simply was not available anywhere in the area for inspection.

After some deliberation, the decision was made not to list and describe individual pieces of equipment, except as part of the text. This was done because two publications provide excellent, complete descriptions of all known devices and are much more complete than anything we could have compiled. These publications are:

Commerce Clearinghouse, Inc. Automation Reporter. 1965- looseleaf.

Auerbach Corporation. Data Communications Reports. 1965- looseleaf.

Either or both of these publications should be used to obtain technical data and industrial applications.

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I. Introduction:

Libraries at mid-century were faced with a critical situation regarding the ever-increasing output of printed information, along with a lack of sufficient funds to provide for the acquisition, bibliographic control, storage and service of the collection. While in the past, scholarly libraries had attempted to collect all of the output of the world's presses, this proved to be an increasingly costly if not impossible job. Cooperation seemed to be the answer, and various schemes were devised by imaginative librarians. The well known Farmington Plan, the Midwest Interlibrary Center, cooperative acquisitions programs among groups of libraries as well as an improvement in interlibrary loan arrangements on a regional basis were some of the steps toward informal association of groups of libraries. Public libraries pioneered in making these associations more formal; the formation of regional public library systems in the early fifties constituted examples of a network of libraries established on a contractual basis, and with firm financial foundations.

The formalization of the network concept was soon incorporated into library planning at the regional and national level. State libraries began to conceive of their jurisdiction as a system rather than unrelated groups of different libraries. Regional reference centers were designated within some of the states, which would serve as resource centers for smaller libraries. It soon became apparent that when such systems came into being there

was a need for communication among its members - communication much more rapid than thought necessary thus far. Copies of wanted books had to be located quickly in order to make the total resources of the system available to the borrower at the local branch. When it became apparent that the desired item was not in the system, there was a need for quick location elsewhere. Libraries turned to electronic communication for speeded-up service.

Communication technology had developed rapidly during the fifties. Teletype machines had been improved so that they were now well-suited to library applications. Facsimile devices had become practical for the transmission of printed information via telephone line. The computer became an important part of library planning, with its many attractive uses for both library housekeeping tasks and the dissemination of stored information over a wide geographic area.

Thus the stage was set for libraries to make use of both the organizational base which had developed and the new technology which would provide the means toward developing interlibrary communications systems.

In the following pages, various kinds of interlibrary communications devices are described. A special section deals with broad surveys of the entire field, each of which contains additional references not cited in this paper.

A brief treatment of the biomedical field follows, and the paper ends with a glimpse into the future.

II. Interlibrary Communications Systems:

A. Surveys

Several surveys were found which provide good background material on electronic communications systems as well as specifics. Scott Adams' survey, made in 1956, is the earliest and one of the best found in library periodicals.(1) He describes the use of several kinds of equipment including TWX, tracing the history of teletype in libraries. His look into the future is uncanny, foreseeing the use of CRT's and facsimile for libraries, something which is just now becoming reality.

Arthur Jones,(8) describes various kinds of communication links and different kinds of terminals which could be used by libraries. Computer-switched teletype, complete communication terminals, consisting of CRT's, with light pens, typewriter keyboard, and facsimile transmittal of hard copy are described, and some of the problems preventing libraries from taking advantage of existing technology, chiefly cost, are mentioned. Solutions suggested include sharing of line costs, trunking, and careful planning among systems of libraries.

Becker(3) provides an excellent framework for libraries planning to participate in communications networks. After outlining developments and current status of technology, he describes existing and planned networks and invites librarians to participate in the planning as early as possible to insure maximum benefit.

A study of particular interest is that made by the Houston Research Institute,(7) comparing equipment and suitable communications

networks for libraries. It is most unfortunate that this writer could not gain access to this study, which is most likely a very useful tool for anyone contemplating an installation.

Several works have appeared during the last few years which have treated of library automation as a whole. Proceedings of the Airlie Foundation conference,(5) held in 1963, contain a most excellent chapter on library communications, including hardware descriptions, costs and theoretical considerations. Although Bourne(4) mentions teletype as such but briefly, his book contains good descriptions, cost figures, and other information on terminal equipment of all kinds. Both(6) and(7) suffer from being out of date as far as cost figures go but are still useful.

AT&T's little book on data communications(6) is an excellent survey over the whole communications field, not particularly from the viewpoint of librarians, but, perhaps because of this, required reading for any librarian planning a system. Theory is made simple and easy to understand, equipment descriptions are good, and concepts well explained.

The recent survey on library automation,(10) conducted by SLA and LTP, yielded disappointingly little except numerical counts of equipment used. A state-by-state breakdown of terminals and communications devices, by purpose, is given in Table 1. Unfortunately, the survey did not describe what brands of equipment were being used. It is hoped that the survey questionnaires will be further evaluated.

TABLE 1

TERMINALS AND INTERLIBRARY COMMUNICATIONS
DEVICES IN AMERICAN LIBRARIES, 1966

STATE	A-P		AIM		SC		CC		CDC		CCP		BCP		AL		KWIC		RSDR		RSDaR		CAS		UL		MM		IIC		O		TOTAL
	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	T	C	
New York			2	1					1		2		1	2			1				1									3			20
California			1				1				2		1	1																4			10
Pennsylvania	1																													1			2
Illinois																					1				1					1			3
Ohio			1		1						1		1				1								1					1			7
Texas											1												1							1	1		4
Michigan			1		1						2		1												1	1			3			12
New Jersey																													1	1			2
Florida	1																													2			3
Indiana																														6			6
North Carolina																														3			3
Missouri			1								1																			2			4
Virginia																														4			4
Wisconsin							1																1							1			3
Minnesota																			1														1
Maryland															1										1					1			3
Kentucky																														2			2
Washington			1																												1		2
Connecticut									1																					1			2
Kansas											1																			1			2
Nebraska																														1			1
Rhode Island			1				1						1																				3
District of Columbia	1																													1	1		3
Canada	1		1		1		3		2																					5			13
Massachusetts					1					1		1			1				1						1								6
Arkansas																														1			1
Montana																														1			1
Vermont																														1			1
Total	31		90		31		24		92		100		32		90		40		20		20		11		51		00		450		30		124

Legend

A-P - accounting-payroll bookkeeping
AIM - acquisitions of library materials
SC - serials control
CC - circulation control
CDC - classified document control
CCP - catalog card production
BCP - book catalog production
AL - accessions lists
KWIC - KWIC index
RSDR - retro srchs document retrieval
RSDaR - retro srchs data retrieval
CAS - current awareness service
UL - union lists
MM - microfilm materials
IIC - interlibrary communications
O - other
T - terminal
C - communication devices

Source: (10)

Probably the most useful treatment of our subject was found in the first volume of ADI's Annual Survey of Information Science and Technology.(2) In fact, had this writer known about the book earlier than April, she would probably not have undertaken this assignment at all - finding everything said better and with more expertise in this volume. However, it only covers events through 1965 and deals only with major developments; thus this paper will be a useful adjunct.

The volume is divided into thirteen chapters, ranging from information needs and uses to automatic language processing, and from hardware developments, to information system applications. Chapters 8 (New Hardward Developments), 9 (Man-Machine Communications), 11 (Library Automation), and 13 (National Information Issues and Trends) proved to be especially appropriate. Each is written by an authority on the subject, is critical, and provides excellent evaluations. Comprehensive bibliographies contain many references not cited in this paper. It, too, is "must" reading for anyone interested in interlibrary communications.

Pollack's "Bibliography of Communication Network Studies"(9) provides a number of citations to highly technical papers on communication theory, design of networks, switching and buffering systems, simulation and the like.

1. Surveys - List of References:

(1) Adams, Scott. "Library Communications Systems," Library Trends 5 (0,56) 206-15.

(2) American Documentation Institute. Annual Review of Information Science and Technology. Vol. I. Edited by Carlos A. Cuadra. Wiley, 1966. 389p.

(3) Becker, Joseph. "Communications Networks for Libraries," Wilson Library Bulletin 41 (D,66) 383-7.

(4) Bourne, Charles P. Methods of Information Handling. Wiley, 1963. 241p.

(5) Conferences on Libraries and Automation. Libraries and Automation. Proceedings of a conference held at Airlie Foundation, Warrenton, Va. May 23-26, 1963, under the sponsorship of the Library of Congress, National Science Foundation, Council on Library Resources, Inc. Edited by B. E. Markuson. Library of Congress, 1964. 268p.

(6) Gentle, Edgar C. Data Communications in Business. American Telephone and Telegraph Co., available from Publishers Service Co. 1965. 200p.

(7) Houston Research Institute. Preliminary Feasibility Study Comparing Equipment and Suitable Communications Networks for Interlibrary Loans. Houston, Texas. 1965?

(8) Jones, Arthur E. "Sharing Communications Networks," Special Libraries 56 (D,65) 705-7.

(9) Pollack, Maurice. "A Bibliography of Communications Network Studies," IEEE Transactions on Communications Technology 13 (D,65) 552-4.

(10) Special Libraries Association. Documentation Division. Use of Data Processing Equipment by Libraries and Information Centers. Survey prepared by Creative Research Services, Inc. for...and the Library Technology Program, American Library Association. New York, 1966. 160p.

B. Mail.

Interlibrary loans between libraries have been the well-established means of sharing library resources. Traditionally, requests have been sent by mail, in a standard form devised by librarians, and backed up by the ALA Interlibrary Loan Code, which provides rules and determines lending policy. Although the system has worked well over the years, it is slow. Time elapsed between patron's original request and receipt of the requested document by him ranges from one week to several weeks. Proximity of the lending library, availability of the material in the first library asked, and the absence of location tools all affect the time factor. In recent years volume of mail handled in the U. S. has increased at such an accelerated rate that bottlenecks and slowdowns have become the rule rather than the exception.

Some libraries have considered using bus delivery rather than mail; others are using local delivery service which has speeded delivery in urban areas considerably. However, if material is requested and loaned by mail, the patron may expect to wait a considerable number of days for delivery.

C. Telephone:

The telephone has provided significant speed-up of interlibrary loans and other inter-library communications, when used. WATS lines installed by many larger libraries provide rapid voice communication within a given area at inexpensive

rates. However, transmission of information is often complicated by the need to spell carefully what is otherwise transmitted in printed form. The absence of a printed record results in errors, which can only partially be offset by spelling and verifying the transmitted information orally. Considerable time elapses and the savings in delivery time is offset by higher telephone costs. Too, the library receiving the request must make a record from the telephone conversation, while the Interlibrary Loan Code provides that all record-making, verifying and account keeping is done by the borrowing library, in order to ease the burden on large lending libraries.

A recent development of promise is the introduction of Touch-Phone in many areas in this country. With this instrument, which is presently available on request from the local telephone companies, but will no doubt be installed as standard equipment before long, it is possible to transmit digital information.

The Touch-Phone(8) has a set of buttons instead of the traditional dial. A number is keyed into the set rather than dialed, and it can also accept numbers from pre-punched cards. When libraries have information in machine-readable form, requests for this information could be sent directly to computers, by Touch-Phone, and the answer printed out on any number of devices presently available (to be discussed later). Thus a library or individual could have terminals, relatively inexpensively, to

obtain information when needed. It could not be ascertained if such an application is in existence as yet.

D. Teletype:

Teletype is one of the older means of electronic communications. It has been used by Western Union for years to transmit telegrams, and by newspapers to transmit stories. Stock exchanges have used it to keep brokers apprised of the latest stock market developments.

The system consists of teletypewriters at the receiving and sending end and a communications link, usually a voice-grade telephone line. The system can use leased lines, wired into the machine, resulting in a closed-circuit system. Participants may communicate with each other only. If it is desirable to have access to all other teletype users, a teletype system may use common carrier telephone lines, and may thus gain access to all other points here and abroad, which have TWX service. A number for the destination is dialed, similar to a telephone number, a switching center provides access, and the connection is made.(8) This system is commonly known as TWX here and as Telex abroad.

Various teletypewriters are in use or being developed. The Teletype Corporation is the chief manufacturer of these devices, which range from simple print-only machines without answerback capability (used in newspapers for one-way communication) to

terminals transmitting messages at the rate of 150 w/p/m, and which have automatic unattended answerback service.(8, 13)

The chief advantage of teletype is its relatively low cost, both for line charges and for rental of equipment. Some libraries have recognized the inherent advantages of such a system and have chosen it as a means of accelerating their interlibrary communications.

1. History:

With the exception of one closed-circuit teletype system, installed in the Philadelphia Free Library in 1927 to provide communication between stacks and circulation area(23), teletype became popular among librarians in the early fifties. Several survey articles cover the field fairly well; however, additional references are listed to complete the picture.

Jolly(14) wrote about teletype in libraries as early as 1954. He found that the first installation connecting two libraries was made between Milwaukee and Racine, Wisconsin. Racine's limited collection was no longer adequate to the demands of its patrons, and speedy access to a larger collection was thought to be the solution. Teletype proved to be less expensive than telephone calls; in addition, it provided printed output to the lending library, insuring accuracy of bibliographic information. A daily messenger service between Milwaukee and Racine was instituted for pick-up of library materials. A per-book charge was paid for each item loaned; additional costs included the rental of both teletype machines, (at that time $10 per month each), messenger's salary and line charges. Costs per item loaned were $.76, later increasing

to $1.02, when teletype rental fees went up.(22)

A disastrous fire which destroyed the Michigan State Library in 1951 gave impetus to the establishment of the first teletype network. In order to provide services as usual to its libraries, the State Library installed TWX in the Detroit Public Library, the library of the University of Michigan, and Grand Rapids Public Library, as well as on its own premises.(27, 31) These libraries' resources provided the needed interim service while the State Library rebuilt its own collection. When teletype charges increased, the system was abandoned.

The Midwest Interlibrary Center came into being at about the same time. Most of its members installed TWX to facilitate access to the MILC collection. Later it was found, however, that because of the nature of the collection,(little used materials), the service, too, was little used, and many members abandoned it. (1, 4, 7, 14, 23) Costs for this system ran considerably higher, partly because of the long distances separating members, and also because of increased TWX charges mentioned above.

The Library of Congress installed its TWX in 1952, thus making its resources available to all libraries with a similar installation. (1, 14, 23, 30) This no doubt gave some impetus to the continued increase in installations which numbered 24 in 1959 when Mack surveyed the field again.(19) Eight campuses of the University of California system and the Missouri State Library had installed TWX in 1953,(1, 4) while New York (10, 21, 24) and North Carolina (28) joined in 1958.

1958 also saw the publication of two reports which identified additional uses of TWX for reference and catalog look-up.(20, 35) These reports were not available to the author for inspection.

Mack updated his 1958 survey in 1964 and noted an increase in libraries with TWX to 65.(18) A comparison of cost figures at his own installation (Lehigh) showed a decrease from $.91 per item to $.88. He ascribes this to improved handling of messages as experience was gained.

Colorado installed TWX as a demonstration project in 1963. A service center in Grand Junction collects requests from about 40 small public libraries: those that cannot be filled are forwarded via TWX to the Denver Public Library and subsequently to the Bibliographical Center for Research for location of titles.(16, 28) The Center is also tied to several of its member libraries via teletype, as well as to the Nebraska State Library which maintains its own Union Catalog and teletype network, but refers requests which cannot be located to Denver.

Indiana installed TWX in four university libraries and 21 public libraries in 1965. The system is used for all types of messages, in addition to interlibrary loan requests.(28) Very little has appeared in print about Indiana's installation thus far.(15)

Pennsylvania installed teletype in its four regional reference centers in addition to the Union Catalog which had had the service since 1957.(26, 29) Maryland now has service between the Enoch Pratt library and all county library systems in the state: this,

however, is a closed-circuit system, using leased lines. Pratt library has been designated as the state reference resource center. Its two teletype machines provide rapid access to its collection for all Maryland public libraries.(6, 32)

The latest installation to come to our attention is that linking Rhode Island and Connecticut together. The Providence Public Library and the Connecticut State Library have installed TWX, while they, in turn, are connected to other public libraries in the area by a closed-circuit system.(11)

The Bell System made a proposal to a group of medical libraries in 1965, to install TWX for improved interlibrary loan service.(3) Several states were involved: Virginia, North Carolina, and the National Library of Medicine in Washington, making this the first multi-state plan. The proposal has since been implemented, and the University of Kentucky Medical Library has joined the system. Several other libraries (University of Mississippi Medical Center, LSUNO Medical School) have since "joined" on an informal basis, that is, they all use the same format for transmitting interlibrary loan requests, designed by Warren Bird of the Duke Medical Center Library.(33)

While the use of TWX was increasing rapidly in the U. S., parallel developments were taking place abroad. Canadian libraries had joined Telex(the Canadian and European equivalent of TWX) in 1963,(9) but during Canadian National Library Week in 1966, a national demonstration network was established, linking 24 libraries

from coast to coast. Primary use was for interlibrary loans; in addition, for one hour per day, cataloging information was distributed to all participating libraries, using punched paper tape.(34)

Europe, blessed with low transmission rates, and a teletype missionary in the person of L. J. Van Der Wolk, librarian at Delft Technical University, experienced a much more rapid growth in library teletype installations than this country. The first teleprinter was installed in 1955, somewhat later than here. Growth from then on was rapid.(12, 25, 36) Denmark installed Telex in every major library in 1963.(2) Van Der Wolk identified 27 libraries in 1958; this number grew to 821 in 1966 (including U. S. libraries, and those in other parts of the world, as well as those libraries which do not have their own machine but can use that of their institution).(38) Unfortunately no separate count for European libraries was made: however, it appears that the constant and voluminous exhortations by Mr. Van Der Wolk had the desired results. He states, with rightful indignation, that there really is no reason why libraries should not install teletype immediately, and that 821 out of the world's 8,700 university libraries is a small percentage indeed.(38)

The 1965 TWX directory for the United States reveals 130 library subscribers: the 1966 figure should be substantially higher, however, because of the increased interest shown in interlibrary communications of all types.

2. Uses and Advantages:

What are some of the uses of a teletype installation in libraries? Poole lists six (23):

interlibrary loans

augmenting holdings on reciprocal basis

general communications with other libraries

use for querying union catalogs(37)

reference services

internal communications

A number of additional uses have emerged since then: the transmission of bibliographic data for cataloging was cited in the report on the Canadian network (34), as well as by Hayes (10) of New York. Circulation control was mentioned by both Hayes and McClellan.(17) The latter, in a most unorthodox article on accessibility of library materials, describes a system he has installed in his Tottenham, England, Public Library. He combines Desk-Fax, a short-range facsimile device with Telex for longer distances to provide his branches and departments with rapid access to the "master catalog", which contains single cards for each item in the collection, whether cataloged or not. A "Central Locations Unit" staffs the location service and transmits the desired information via fax or teletype. A mechanized file aids the staff in locating the desired information. All reserves will be handled by this unit whose sole job it is to keep up with and provide information about the location of every copy of each book in the system.

The advantages of teletype as surveyed by Poole are as follows:

Speed	Accuracy
Cost below telephone	Increased resources
Clarity of foreign languages	Simultaneous written records at both ends
Increased range of library service	Ability to use codes and prepunched message tapes
Round-the-clock unattended service	Improved public relations

The use of codes in Europe seems to be much more widespread than in this country; Van Der Wolk describes the IFLA/IATUL Telecode and Telex Addressbook(38), which contains the international code used by libraries. This code, based on letter combinations, is both short and easy to memorize. Each symbol consists of three letters standing for words and phrases most heavily used in inter-library communications. It has been translated into ten major languages so that it is truly usable by all nations. Its chief advantage is brevity, of course; shortening messages drastically by the use of this code cuts down considerably on the cost of transmission. Too, it provides an international standard of communication which might well be adopted more widely among libraries.

Advantages of teletype might well be summed up by quoting Rogerson(25): "The speed of a telephone with the authority of the printed word."

3. Costs:

Cost figures vary widely among libraries; some quote total cost per item handled, including personnel, TWX, mailing or messenger service, while others include transmission charges only in their cost figures. In addition to the cost figures by Mack, Jolly, and Pethybridge, given above(14, 18, 19, 22), there is our ever-enthusiastic Van Der Wolk, writing on costs in Europe which seem low indeed. A three-minute transmission over fifty miles in Germany costs all of 2.5¢, while 150 miles cost 15¢. He has calculated the cost of a call from England to several European countries as follows:(36)

To Austria	12s 0d
Belgium	4s 9d
France	4s 6d
Netherlands	4s 9d
Switzerland	6s 9d
West Germany	6s 9d to 8s

In addition, he provides useful comparisons between telephone and teletype costs in Europe as well as figures about usage of his own installation.(36, 37) Use figures are also given by Hayes for New York, where the increase in items handled has been phenomenal(10) and in a subsequent article on the same installation.(21)

It appears that wherever TWX has been used to maximum advantage, that is, as replacement for traditional means of

communicating with other libraries, rather than in addition, it has become a quick, accurate, and inexpensive tool. Hopefully, the recent increase in installations will stimulate interest in some meaningful cost studies, which are badly needed at this time.

4. Recent Developments:

Some recent developments have made the teletypewriter appear in a new light. The equipment itself has been improved considerably. Where transmission speed had been 60 w/p/m, it has been increased in the mod. 33 and 35 teleprinters to 100 w/p/m. Unattended service has become the rule rather than the exception, providing teletype users with a 24-hour per day capability to receive messages. Punched paper tape as part of the machine has resulted in speedier transmission; a typist may type as slowly and carefully as necessary to prepare an accurate message without tying up a line; when the message is completed, the tape, which was prepared simultaneously with the typed message is read and transmitted at 100 w/p/m, considerably faster than most typists can prepare a message. The teletypewriter model 37 being tested now, which will appear on the market this fall(1967), will be even faster, transmitting at 150 w/p/m.(13) Rixon Electronics, Silver Springs, Maryland, has developed a machine which can transmit at 4,800 b/p/s, as compared to Teletype's 2,400 b/p/s.(13)

A new terminal device is being market-tested at the present time(12a) and should be available commercially this fall(1967). Called Dataspeed, its chief advantages are speed and silent operation. Printed characters are formed by ink sprayed from

tiny nozzles onto ordinary TWX paper. Any character can be programmed to print; transmission is at the rate of 1200 w/p/m or 120 characters p/s from perforated tape transmission. Its price is modest, and since it has few moving parts, maintenance is simple.

The most important change, however, is in the use to which teleprinters are being put. The concept of teleprocessing of digital information as input to computers has developed rapidly during the last few years. In 1965, this concept was demonstrated at the Library/USA exhibit in New York; its UNIVAC computer was connected to cities considerable distances away by telephone lines with teleprinters as terminals. Questions could be asked from the information stored in the computer and were printed out via teleprinter in the distant city.(5)

Several libraries in New York State envision using their present TWX service in conjunction with present or proposed computer facilities, to obtain bibliographic data, to query registration files, and to receive pre-recorded answers to frequent questions.(10)

Additional information on teletypewriter uses with computers is given in another section below.

5. Summary:

Aside from a few surveys of the teletype field, cited in section A above, the literature is devoid of comprehensive treatments. Few cost figures are given, and those that are stated

usually do not give a method by which they were determined. Most of the articles brimmed with enthusiasm over a new machine which would perform miracles; few gave hard facts to back this up.

However, it may be concluded that the uses to which teletype machines have been put have been practical and worthwhile. Expanded uses in the future are a virtual certainty, both because of the low cost, as compared to similar devices, and the improvement in the equipment itself.

6. Telephone and Teletype - List of References:

(1) Adams, Scott. "Library Communications Systems," Library Trends 5 (O.56) 206-15.

(2) Barnholdt, B. "Telex i Danske Biblioteker," Bogen Verden 46 (Jy.64) 239-42.

(3) Bell System. Medical Interlibrary Communications Exchange Service (MICES). A Pilot Project to Determine the Usefulness of Teletypewriter Exchange Service for Interlibrary Communications. Participants: National Library of Medicine, Duke University Medical Library, Bowman Gray School of Medicine Medical Library, University of Virginia Medical Library, Medical College of Virginia Medical Library, University of North Carolina Health Affairs Library. 1965?. unp.

(4) "Cooperation in Missouri." ALA Bulletin 53 (Ja.59) 65.

(5) "Dial-A-Visit to Library/USA." ALA Bulletin 59 (Je.65) 428.

(6) Duchac, Kenneth F. "Public Library Development in Maryland." Library Journal 92 (Mr.15,67) 1113-16.

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E. Facsimile:

Facsimile transmission of printed information has intrigued librarians for many years; up until recently it was the only means by which a printed page could be sent over appreciable distances without requiring typing or otherwise manually duplicating text.

Actual transmission takes place over voice-grade or wide-band telephone lines, microwave and similar communications links. A scanning device picks up images optically and translates them into electrical pulses. At the receiving end, print may be restored by a number of different means. In a direct-recording facsimile system, current may be passed through electrolytic paper, resulting in letters being formed; or a white coating covering an electroconductive carbon paper may be burned off electrically. Another way is to guide a magnetic stylus over pressure-sensitive paper, actually "drawing" the message. The fourth method is the well-known xerographic process, using a cathode-ray tube to form an image on a selenium-coated drum. This drum is dusted with a powder ink which adheres to the charged areas only, is transferred to ordinary paper and heat-fused for permanence.

Synchronization of both scanning and recording mechanisms is extremely important for the success of facsimile transmission and a number of highly sensitive devices have been developed by several manufacturers to achieve a high degree of reliability within sending and receiving sets.(7)

Speed of facsimile transmission depends on the capacity of the communications link. Over voice-grade lines, transmission may be at the rate of one page every six minutes; or as fast as several pages per minute, if microwave is used.

1. History:

Facsimile, or "fax" as it is often called, has been widely used for message telegraphy, weather and cloud picture transmission, and newspaper stories. Some newspapers are type-set in one city, and printed by high speed facsimile in another.(5) Photographs of news events are sent via fax to distant places.(4)

The first article on fax in libraries was written by Cedric Larson in 1952.(13) He describes a prototype facsimile device designed for the Atomic Energy Commission which could scan print on a flat surface, thus being usable for copying from books. As yet, such a device is not available commercially, although fifteen years have elapsed since the AEC device was first tested. It used a cathode-ray flying-spot scanner at the sending end for pick-up of impulses. Speed was fairly high for this machine; it transmitted at the rate of 15 in. per minute (or 120 sq. in. per minute). Electrolytic paper was used at the receiving end to reproduce print. Adams(1) and Heron(8) also describe this device, but no explanation is given why it remained a prototype only and was never commercially produced. One may only guess that the cost was prohibitive, else some enterprising manufacturer would surely have seen a ready-made market among libraries and other customers who have need to copy from bound volumes.

Crooks presents a good description of the entire facsimile field as of 1954.(4) He tells of Deskfax, widely used by Western Union to send messages to their customers' offices, using Teledeltos paper, a coated carbon paper. Weather maps transmitted over land lines and radio use Times-Fax; in Canada a similar system operated under the name of Mufax. Hogan Laboratories, a leader in the design of facsimile equipment, had developed a continuous scanner by 1954, which accepted copy of varying sizes without the necessity of re-loading the machine. Crooks foresaw vast improvements in fax equipment by 1955, envisioning tens of thousands of sets being sold to an entirely new user group by 1956. Desk-to-desk, office-to-office and plant-to-plant communications would become feasible, editors would be able to receive and send proofs by fax, protected files would become a reality (no document ever leaves, but copies are made instead.) Improved speed of fax would become reality. Mr. Crooks states that no one could guess how fast fax reproduction would become and that increased availability of wide band communication lines at an inexpensive rate would make it practical for many more customers. Thirteen years later we find that line cost is still the chief problem, most of his technical predictions having come true meanwhile.

Scott Adams(2) writes again in 1956, surveying all types of library communications systems. He describes Telautograph, a fax device which prints on continuous rolls of paper and states, "it has been installed in a number of libraries for intercommunication

between circulation and stacks." The only library named is the John Crerar Library in Chicago, however. He, too, peers into the future, envisioning a projection of one page at a time on the face of an iconoscope tube and subsequent print-out.

King's article in 1960(12) is one on the most soundly conceived ones found in this survey. He advocates electronic transmission for interlibrary loans and comes up with some excellent comparative cost figures, taking into consideration the many intangible costs inherent in ILL transactions. He compares line costs for various kinds of transmission and concludes that electronic communications links between libraries are only feasible when a very high volume of activity exists and the distances are relatively short. He does recognize the public relations value of instant receipt of the requested item, but concludes that there are "few present or anticipated situations where distance and volume would result in competitive economics."

1960 saw the publication of an article by Kennedy(11) which was not available for examination. Next we find a brief note in Library Journal(18) announcing the experimental installation of a facsimile system between the Franklin Institute Library in Philadelphia and the GE Missile and Space Division at Valley Forge (20 miles). The article gives no cost figures and does not state what kind of equipment was used but does state that interlibrary loan time was cut from 10 days to five minutes! This seems hard to believe considering the size of the Franklin

Library, where it surely took longer than five minutes to get a journal volume from the stacks.

David Heron and J. R. Blanchard(8) next write of fax, this time in 1966. In tracing the history of library applications, they find that the Council on Library Resources has shown great interest in facsimile transmittal, supporting various projects to aid technical development. While turning down a proposal for LDX in the Boston area, the Council funded an experiment in Nevada, which linked the University of Nevada at Reno and the Las Vegas campus with the Davis campus of the California system. Morehouse's report on this project reveals further details.(17) Magnavox Research Laboratories' new Magnafax device, later known as Xerox Telecopier, was installed in the three universities in April, and a one-month experiment began. Regular voice-grade lines were used for transmission. All types of printed materials were transmitted during the test period to ascertain to what extent the machine was suitable for general library use.

Results were both encouraging and disappointing. Less than 8-point type could not be reproduced legibly, although larger type transmitted fairly well. Use of voice-grade lines resulted in considerable noise, bad connections and fading; since the machine "copies" noise, many of the copies were illegible because of line interference. The installation of a data-grade line at slightly higher costs was recommended for the elimination of line problems. Too, the equipment used was among the earliest production models, relatively untested, and therefore prone to troubles.

Chief advantage was the time gained in the actual transmission of pages over the more conventional method of xeroxing and mailing. Additional time was also gained by establishing priorities for the experiment, e. g. in the immediate use of the Xerox machine when needed. This, of course, should not be considered a real time-savings, since such priorities could be assigned to any inter-library loan system, if deemed necessary.

Heron adds to this report that faculty complained about the lessened legibility of transmitted copy. No other statements regarding user acceptance were found.

In Hawaii, the State Library installed facsimile copiers in 1966.(9) Hunt describes his use of Diktafax equipment in enthusiastic terms. Because of the varied background of his clientele, it is often necessary to transmit Chinese, Japanese or other Far Eastern language: facsimile transmission is a boon to this effort. Not only was material copied for interlibrary loans, but book orders, administrative memos and the like were sent. Among the islands of Hawaii, facsimile transmission would appear an ideal way of communication, since most mail has to be flown or sent by boat, making it either expensive or slower than land mail. Simultaneous transmission proved to be another advantage of the equipment; Mr. Hunt was able to communicate quickly and efficiently with his charges in this manner. He envisions tying the fax equipment into his proposed computer network, and also making it available to other state agencies for communicating with their local offices.

A second experiment with fax, this time between Berkeley and Davis campuses of the University of California system, has just been concluded. A report will be available in June of 1967. Ralph Shoffner,(15) head of the Task Force, writes that careful testing of assumptions made in a planning report published last year will be part of the June report. Based on the Nevada experience, Morehouse and Shoffner(16) planned the LDX experiment in California, again sponsored by the Council on Library Resources. Carefully calculated time and cost estimates, both for the proposed Davis-Berkeley link and for a network encompassing nine UC campuses are presented, and await testing. The report concludes that an LDX system is not economically feasible with present volume of interlibrary loans, but that the cost may be justified in gaining access to vast collections for smaller libraries, thus in many cases eliminating the necessity for the acquisition of duplicate titles.

Several ongoing or planned projects are but briefly mentioned in the literature, being too new to merit evaluation. A letter from LSU(14) states that the proposed LDX installation which would tie that library to others in Louisiana and Mississippi is dormant at the present time, due to lack of funding. A number of requests for grants were turned down for LSU, and it is presently considering a smaller system between three LSU campuses only.

Shoffner writes of a system presumably in operation in Indiana; as yet no information could be obtained on this(15). New York's

pilot project began in February of 1967,(6, 10) encompassing five libraries: New York State Library, New York Public Library, Cornell University, and the public libraries of Buffalo and Erie County, and Rochester. Eventually, this group will be expanded to include twenty-five research libraries in New York state. Service will be given only to the "serious researcher, over eighteen, who knows his exact bibliographic citation." A charge of 25¢ per page will be charged the patron, and he may receive no more than 12 pages at one time. His request will be transmitted from the local library to the nearest library having a facsimile device; if it cannot be filled there, it is forwarded to the State Library, which will query the entire system.

2. Costs:

Few cost figures are available as yet. Hunt(9) states that at 18¢ per copy, this is 300% less than the cost of copying, packing, mailing and postage of a given item. This very low figure is in sharp contrast with those given by others, and it must be assumed that he considers only the actual transmission cost and not total cost of handling each item. King's cost figures were mentioned above(12). They are, however, probably out of date as of now. The Airlie Foundation proceedings contain an excellent chapter on library communication networks(3), which provides extensive cost figures. Line costs using various kinds of links are considered in relation to distance, and one table (p. 218) even considers the cost of transmitting a whole book (The Rise and Fall of the Third Reich), exclusive of terminal equipment, however.

Morehouse(17) is the only one who does have firm cost figures, ranging from $2.49 per page between Las Vegas and Reno to $.88 between Reno and Davis. Because of the fact that his was an experimental situation, these figures may not be entirely usable for anyone considering an installation of fax equipment. They do, however, present a starting point, and Morehouse is careful to point out that alternatives exist, especially as to line costs, which would make the service more satisfactory in a working situation.

When the report of the California LDX experiment is issued, it should be incorporated into this report. Efforts should be made to obtain data from New York when sufficient time has elapsed to make such data meaningful.

3. Recent Developments:

Libraries are not likely to use facsimile transmittal on a large scale unless line costs are decreased. Terminal equipment appears to be reasonably satisfactory except that none of the commercially available machines copy from bound volumes as yet, making it necessary to use another copier first and then using the resulting single pages for transmission copy.

A relatively recent development in several states towards statewide communications networks is of great importance for libraries. If line costs can be shared with others, if libraries can subscribe to a public utility-type broad band network as they do now to voice-grade lines, then it will become much more practical

for even smaller libraries to take advantage of fax. By sharing such networks, a much more efficient transmission method can be used. Microwave is one, waveguide and satellite communications two others which are being used now. The possibility of laser transmission is coming much closer; some of the formidable technical problems are in the process of being solved. None of these very expensive transmission links are economically feasible unless a very large group of users subscribes to them, necessitating the formation of user groups on a broader basis than the statewide networks now being formed.

4. Summary:

Although few libraries have used facsimile for transmission of printed information as yet, 1966/67 saw the installation of several major systems, some only on an experimental basis, while others are operating networks. Decreasing line costs will no doubt make facsimile equipment more widely acceptable: it remains one of the most attractive means of transmitting printed information, because of its accuracy and speed.

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F. Television and Radio;

1. History:

The use of television for interlibrary communication has not received a great deal of attention in the literature. Libraries have, of course, been interested in TV for some time, but this has been mostly in terms of presenting book talks and other library-connected programs on educational television stations. A demonstration of this type of use was presented during the meeting of the Michigan Library Association in 1961.(4) The Detroit Public Library was connected to the convention hotel, and viewers could see panel discussions, in-service training lectures, the transmission of printed information, diagrams, pictures, etc. in answer to reference questions. This demonstration was designed to arouse interest among Michigan librarians for a proposed statewide ETV network. As yet, this network is not in existence. Dance(5) tells of the Michigan demonstration as well as operational closed-circuit networks in Texas, South Carolina, Florida, Alabama, and a county in Maryland. These have been used by libraries for transmission of reference-type information, (cartoons, costume plates, diagrams); some Polaroid pictures of the screened image were taken and were of good quality. One wonders why libraries have not used their ETV networks to a far greater extent; it seems that the screened-image Polaroid method could be used very successfully for the transmission of journal articles. Night transmission should be possible, when

stations are officially off the air, so that patrons would have the material in hand the next morning. It can only be guessed that proximity to the station might be a problem; all library materials would have to be transported from the library to the station each night and back again.

Evans(8) relates an interesting experiment, conducted at the Library of Congress in 1948. It concerns a demonstration of Ultrafax, during which Gone with the Wind (1047 pages) was transmitted from a hotel five miles away to the Library of Congress in 2 minutes and 21 seconds. The method of transmission was a flying spot scanner at the input end, transmission of the television image over microwave, and reception on a kinescope or picture tube, from which either a videotape or a hard copy could be made. The received image was first recorded on fast-acting film which was developed almost instantly. Gen. Sarnoff, who spoke at this event, foresaw all sorts of exciting uses for Ultrafax: exchange of TV programs with overseas countries, a worldwide military communications system, distribution of full-length movies from a single film negative to thousands of theaters, home video newspapers projected on one's own screen, and the like. Some of these things have since come true, but it may be assumed that the high cost of such an installation has prevented its widespread use. At any rate, no further mention of Ultrafax is found in the literature examined.

The ever-alert Council on Library Resources became interested in TV applications to library problems in 1958 and sponsored two

studies designed to help solve some of the knottiest library problems standing in the way of TV utilization.(3, 12) In order to examine library card catalogs by television, a card-turning device had to be designed which would feed and turn cards for the camera. Ardern(1) reports on the projects, and finds that the devices were not reliable enough to do the job efficiently. He then continues with his own experience in the Manchester College (England) Library, also described in (7). A one-way closed circuit TV link was installed between the main library and a branch in the Chemical Engineering Building. A camera with two lenses, a screen for lining up copy, and a book mover to facilitate handling of the book being viewed, as well as an intercom system, were installed. The branch library installed a 14 inch monitor for viewing the projected image and a control unit which could switch from one lens to the other. Also, there was a book moving device and an intercom at the receiving end. The CLR-designed page turner was used but proved to be less efficient than a staff member turning pages. Mr. Ardern does not discuss user reactions, but gives cost figures, and states that the high cost of a public utility coaxial cable would prevent extending this system to points farther away.

The VERAC system is described by Bourne(2) and in two other reports.(6, 9) Developed under a CLR grant, it consists of a step-and-repeat camera, film storage and retrieval units, a TV viewing screen and a hard-copy reproduction unit. The

machine was developed by AVCO Corporation of Cincinnati: it features microfilm coding for quick retrieval. One million pages could be stored in the system. Although described as operational and commercially available in the Airlie Conference proceedings (p.134) no mention of any installation was found.

Ampex Corporation's VIDEOFILE is a similar system: however, it uses videotape as document storage device. It is described as being in use at NASA in Huntsville, Alabama.(11, 13) The advantage over VERAC is that it can be updated; disadvantages include storage in the analog mode, thus there is some degradation every time a copy is made.

Only one example of a radio network of libraries was found.(10) Six regional libraries in Southwest Missouri are planning to form such a network for expediting of interlibrary loans, answering of reference questions, and extending the services of professional consultants. This was only announced in March of 1967, and it will be interesting to see if the cost of such a system is justified, compared to telephone conference calls or similar, more traditional means of communication.

2. Summary:

The literature yields little of actual experience with video in libraries. High equipment and line costs appear to make an installation solely for libraries impractical, but it would seem that the use of available educational television networks and stations could be utilized to a far greater extent. A survey

of presently existing ETV facilities to ascertain if libraries avail themselves of their services might be useful. The recently announced plan of a national ETV network would seem to make this a ready-made system which libraries could use to communicate with each other.

They could use the network during off hours for transmission of bibliographic citations and printed material; this would be a one-way communication only, of course, and if hard copy was desired, a photograph would need to be taken of the image projected on the screen.

Another way to utilize the existing and proposed network would be to install slow-scan video equipment in libraries, which would permit reading information off the screen and copying what is needed. The wideband network (ETV) would only be used for long-distance transmission (e. g. from the Library of Congress to the state capitol), and a step-down device would be necessary to convert signals to a voice-grade line, utilized by slow-scan equipment (VIDEX).

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G. Libraries and Computers - The Present Picture:

Although there is much written information on how libraries might take advantage of computers, little solid achievement has been reported as far as total on-line systems are concerned.

1. History:

The concept of a totally mechanized library, tied to branch libraries and other service point via communications link is not new. Everyone seems to have talked about it for years, but few have implemented the total concept. Progress seems to have been made in technical libraries somewhat more rapidly than anywhere else.

The well-known Project MAC at MIT, begun in 1961,(15) is probably the most sophisticated on-line library system conceived thus far. It is, however, an experimental system only, designed to aid in solving some of the formidable problems inherent in such an operation. Much experience has been gained over the years; the installation of more powerful hardware and the constant modification and addition to software connected with this program make it a model from which much can be learned.

MEDLARS(24) is the major program in the health sciences. It, too, is not a total program, but encompasses many of the functions which are essential to the development of a total on-line library concept. In addition to making its information available directly to users throughout the country, by mail, tapes of stored information are being distributed to regional centers, from which local users may draw information. Thus far, it could

not be ascertained if any of the MEDLARS tapes are on-line, and if anyone is linked electronically to the regional centers, but this would seem to be a logical development.

One of the more interesting total systems in existence is that of Socony Mobil Oil (SMAPT).(25) This is not a library-based systems, but contains many of the components of a total library system, and is therefore described in some detail here.

An IBM 1410 computer with an 80K memory is available on a real-time basis to Socony Mobil's installations all over the world. Information is stored on disk packs, and a buffering device (Digitronics) provides the speed-up and slow-down which teletype messages require before they can be used on-line on a computer. A number of different programs are run; financial analyses, system statistics, engineering applications, and mathematical computations. The system can accept as many as sixty-four teletype messages simultaneously. It has an interrupt feature and dual i/o channels with overlap capability, as well as memory protection. In operation since 1964 and working well, it might serve as a model for library operations, since it encompasses all of the company housekeeping functions as well as information retrieval and research work.

During the Library/USA exhibit at the New York World's Fair, an on-line system was demonstrated(6) which used teletypewriters in remote cities as i/o devices. It was claimed at that time that this was the first electronic remote library center ever established.

A person could formulate a question, it would be teletyped, and the answer received from New York very quickly. This was, however, a "canned" demonstration only, with special codes designed to elicit particular answers.

The Library of Congress was studied by King(10) in 1962/63, and the ensuing report presented plans for total mechanization of its operations. Some of this is now getting underway; tapes containing cataloging information, (in lieu of the distribution of printed cards), began being distributed to sixteen libraries late in 1966.(12) No information is available as yet how this is working. Here again, as with the MEDLARS program of distributing tapes, it is conceivable that these tapes might be queried remotely via teletype by individual libraries.

Hayes(8) describes the beginnings of an on-line total library system at the IBM Advanced Systems Development Laboratory at Los Gatos, California. Here housekeeping tasks are being mechanized gradually, with the goal of having all operations controlled by the computer. He recommends that librarians investigate service bureaus or public utility-type computers, to which they may subscribe, thus bringing equipment costs down. The thorny problem of line costs still remains.

Drew(7) reports of his on-line technical library reference and retrieval system at Lockheed. Begun in 1964, it features a card reader as input and teletypewriters as output mechanism. The search is carried on by reading a term card, matching it

against a file of stored terms, thus insuring that the search is made in terms of a controlled vocabulary. Drew does not say if this is a total library system including housekeeping tasks.

Medical libraries have been in the forefront of the movement toward mechanization. The most exciting developments are presently occurring in New York State where the development of the Harvard-Columbia-Yale tieup of their medical libraries has been an ongoing project for some time.(1, 22) This teletype-connected system has undertaken cooperative cataloging in depth, using MEDLARS tapes, and supplementing this information with analysis of books, so that medical library patrons would have far greater access to information than presently possible.

Parallel with this the biomedical communications network was established in upstate New York(3, 11, 16, 18). This project came as a result of an organization called INTRACOM, which was formed among New York State University libraries on a similar basis to EDUCOM nationally. The three medical libraries of Buffalo, Syracuse and Brooklyn are involved in a pilot project, later to be extended to all sixty campuses of the SUNY system. The three libraries will be linked via an on-line, real time computerized network, using an IBM 360/40 computer and, for the time being, IBM 2740 terminals, with telephone lines. IBM 1050 terminals will be added later. Tape, disk and strip storage will be available to the computer and a variety of output devices including CRT's are planned. Conversion of the

three card catalogs to machine-readable form is presently underway; formats are based on MEDLARS and the format designed for the Library of Congress. KWIC indexes and SDI programs are also envisioned. All library operations will be converted to the computer. A Union List of Serials has already been produced, the communication terminals have been installed and are providing improved interlibrary loan service, and a mechanized circulation system is operative at Syracuse. Plans for the SUNY system also include installation of an LDX system, apparently not related to that now being put into operation by research libraries in New York state (mentioned in section on Facsimile).

The budget for the project is set at $200,000 for 1967/68, and for 1968/69 it will cost about $350,000 to $400,000 to operate the system.(11) One of the important considerations in planning this operation is the availability of a computer solely for library operations, to be shared by all participants.

There are many other libraries now using computers for parts of their operation. Emphasis in this report is, however, on the concept of a totally computerized library which could communicate with others on an equitable basis. Thus we have looked only at those libraries which combine cataloging and classification with retrieval in their systems planning. MEDLARS and the MARC project at the Library of Congress(23) are providing a national bibliographic standard which would achieve compatibility between communicating libraries. This is considered essential in any interlibrary communications network on-line to a computer.

The INTREX report(15) offers some excellent considerations which must precede planning of information networks. Building blocks for such a network exist now in many places, others are being planned.

Some of the presently existing mechanized information centers, which could be tied into a national network include: National Oceanographic Data Center(21), Chemical Abstracts Service(20), National Drug Information Clearinghouse(14), National Standard Reference Data System(13), de Grazia's Universal Reference System for the social sciences(5), and some of the large national libraries(4, 17). Little communication seems to exist between these centers; and it was only recently that the National Library of Medicine and the Library of Congress agreed on some common forms of bibliographic input. This, it would seem, is the major obstacle to a meaningful design of networks, aside from the ever-present one of costs.

The concept of using service bureaus has been mentioned before to achieve a partial solution to the cost problem. Bass(2) tells of the Los Angeles Public Library's experience with such a facility: apparently it works well for this very large public library system, which has converted its patron registration files, book ordering, serials control and circulation system to mechanization; its book catalog having been computer-printed for some time before.

There are now some large on-line computer systems in existence, which operate on the service-bureau concept.(9, 19) Westinghouse

operates a UNIVAC 490 with about 300 teletype terminals in remote customer locations. Real-time and batch processing are offered. General Electric's DATANET is offering a special service to hospitals and medical facilities in Massachusetts called MEDINET. Teletype terminals and a central computer are part of this system also.

2. Summary:

There are presently few libraries which have converted all of their operations to a computer base. High costs seem to be the major factor holding many of them back. Although many libraries have access to computers, getting time on the machine can be a problem. The computer service bureau may be the answer to some of the cost problems. Standard bibliographic input is a "must" for any library hoping to participate in an electronic communications network. Further considerations will be presented at the end of the section on planned systems.

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H. The Network Concept:

As scarce as the findings concerning solid achievement in computerization have been, there is an abundance of literature about plans for the future. Some of them are touched upon in the following pages; no attempt was made to do a comprehensive survey. The Annual Review of Information Science and Technology cited above is an excellent and critical guide to all important developments in the field.

1. History:

As early as 1961, John Kemeny of MIT(15) proposed the establishment of a computerized national library, which would grow from 10 Million volumes to 300 Million. However, all information would be stored on microtape, and would be retrieved and projected on screens in libraries over the country upon request. Long-distance telephone would be used to request information. He feels that hard copy storage of books is simply not practical any more, and that miniaturization is the answer.

Systems Development Corporation of Santa Monica developed the BOLD system.(2) This is a citation retrieval system, not concerned with storage of actual library materials. It is probably one of the more comprehensive systems yet designed, envisioning a large time-shared computer with terminals consisting of teletypewriter, CRT with light pen for input, teleprinter and CRT for output. A browsing feature is built into the system; the user feeds his inquiry into the system by closely defined

terms, but by using and/or/not logic, he may increase depth of search and eliminate unwanted areas. He next asks for abstracts of those items he wishes to see, and finally for hard copy from the library.

Ebersole(5) describes North American Aviation's model of an operating national information network. His organization faced the same problem any national network would have: overlapping in indexing, some mission-oriented, some profession-oriented, resulting in variant approaches to similar information. A union catalog is now maintained at headquarters in machine readable form. Each of his service centers was assigned responsibility for indexing in a given area depending on the field covered by each collection. Three types of abstracts are prepared at the time of indexing: Indicative, informative, and critical. Indexing is done at two different depth levels. All information is stored centrally; each branch library may have its own index, on microfilm or hard copy. If a document is indexed by two different branches, the one responsible for that subject area provides the deep indexing, while the other provides additional terms needed for its own clientele.

The article is a most interesting approach toward a multi-disciplinary information network with input from various disciplines in an integrated fashion.

INTREX(18, 20, 24) is probably the most comprehensive plan yet devised, actually moving toward implementation. A step-by-step

approach is presented, beginning with augmented cataloging, which would provide, in addition to the traditional catalog information, abstracts, reviews, journal articles, technical reports and government publications. Even class and conference notes would be indexed. The second phase is the one that seems to be receiving a great deal of attention at the present time: Man-machine interaction. More will be presented later on that subject. Much in the INTREX report is directly related to this report; there is an excellent section on the integration of national information resources into a network. Shera(20), writing on the INTREX conference, feels, however, that too much emphasis was placed on machines, and too little on neurophysiological considerations and the desire of the user to browse.

National library planning has given consideration to the network concept for some time now. ALA's report(1) resulting from the Library 21 exhibit at Seattle proposed a national library system. The Weinberg report(23) horrified librarians with the tacit assumptions that scientists rather than librarians should design and operate such a network. Rubinoff(19) and others have proposed various types of national facilities. The latest and most far-reaching report was that of COSATI, with its well-researched supporting material pointing up the need for a flexible approach to a highly complex problem.(3) These are mentioned here but briefly because most of them have been reviewed and evaluated repeatedly in the literature.

One of the results of these well-advertised plans for a national system has been an effort by libraries to band together. Universities, too, have recognized their information problems and have formed an organization to try to cope with it. INTERCOM(6), the Interuniversity Communications Council, was formed for the express purpose of seeking ways in which computer technology might be applied to higher education and its information problems. EDUCOM(14) is the successor to this organization on a national basis, while the above-mentioned INTRACOM includes universities in New York State.

Texas, too, has been doing some sound planning. A step-by-step approach by which North Texas libraries of all types would develop cooperative projects was published in 1965.(22) TWX between participants, closed-circuit television, an automated catalog in a central computer facility, centralized ordering, circulation control, and direct electronic linkage with information centers elsewhere were part of this very ambitious plan. Holdings would be displayed on closed circuit TV, and LDX system was also part of the picture. A letter from a responsible official, dated March 30, 1967, states that "no portion of this program has yet been implemented, primarily due to inter-university political problems." It would be interesting to know how New York State solved these same problems, which are, of course, present everywhere.

Two specific projects deserve to be mentioned here, because they represent special approaches to the network problem.

Prince George's County, Maryland(7) Public Library plans to share with all county departments the use of a fairly large third generation computer system for all its library operations. The interesting part here is that the librarian was a member of the planning group deciding on the type of equipment to be acquired, a rare occurrence indeed. She was able to communicate special library requirements to the group, and the system to be installed will be in part designed especially for the library. All branches will be tied into the computer by teletype, and bookmobiles will have paper tape punch equipment for circulation records, which can be read into the computer store after the vehicle returns from its run.

The biomedical community has some solid achievements to its credit concerning computer utilization. The June 13, 1966 issue of the Journal of the American Medical Association gives an excellent overview of accomplishments.(4, 8, 9, 10, 11, 21, 25) Korein(10) as early as 1963, used variable field length format for input. Several articles deal with on-line access to the computer from the lab; while the experiment is still going on, the researcher may receive back answers to his problems encountered in the experiment.(8, 12, 25) Computer-aided diagnosis, e. g. analysis of electrocardiagrams via telephone line to the computer, automatic chromosome analysis, and the like, is now a reality in several medical centers. Kent(9) surveys the medical information processing field and describes, besides MEDLARS, the highly

automated operation which is proposed by the Excerpta Medica Foundation in the Netherlands. Three specialized computerized information centers have been set up in the health sciences which will most probably be able to distribute their tapes on the same basis as MEDLARS.

Talbott(21) describes a very comprehensive information retrieval system at the Cox Coronary Heart Institute. Abstracts on coronary disease have been stored on the computer, going back to 1960. These are prepared by medical specialists, and the quality is constantly checked by the user, since he has hard copy available to him on 4x6 cm cards containing photomicrographic images of each page of the original document. The abstracts, stored in data cells for real-time access, are available to personnel in a literature control room; these people are physicians rather than librarians. When a question comes in, the physician on duty formats it and inputs it via typewriter; requestor receives either an immediate verbal reply or a teletyped answer. Regular users are mailed the above-mentioned PCMI cards containing full text of all abstracted journals (1,200 pages per card). A viewer-printer is presently being developed to read and obtain hard copy from these cards. A user profile is maintained by recording the origin and types of questions received. This very comprehensive system is apparently still in the prototype stage, and should be watched with interest in the future.

Two reports deal further with the biomedical information field. Orr(17) describes the results of his study on communication problems in biomedical research as follows: There needs to be better communication, rather than more of it. Technical report literature is less important in his field than in the engineering sciences. Research is mainly centered around academic institutions and is rooted in individual initiative. He recommends strong local biomedical libraries as logical channels for information resources. A report(16) on similar problems in the biological sciences adds that quicker publication, in newspaper form, of unedited papers for wide dissemination would be a boon to the information seeker. The report calls for more meetings, more abstracting services, and most importantly, for more evaluation of published material.

The Engineers Joint Council is establishing a very large computerized information center at its headquarters in New York(13) as part of its work in the control of engineering information. EJC has been engaged in some of the most meaningful work on terminology of any professional group. Over a period of years, a thesaurus of engineering terms was developed which would become the common language for all engineering disciplines. Much effort went into this reconciliation process; Project LEX, a further outgrowth of this work, is now developing microthesauri for the various disciplines to provide more specific access to information without losing the unity of the master thesaurus.

2. Summary:

A number of models for operating information networks have been designed and much attention has been given in the literature to such plans. Much good preparatory work has gone into these, and some of the thorny problems which have prevented implementation of such a network are in the process of being solved, at least in theory.

In the following pages, possible future developments are discussed in terms of the experiences gained in the past and new technology.

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I. The Future:

It is at best risky to make procognostications about the future. Almost everyone has tried their hand at it, and consensus seems to be as far away as ever. However, there are a number of factors which have emerged from a survey of the literature.

1. The Human Element:

How do people go about getting information? What avenues do they choose first, second, third? What is important to them, and what is not? Any system which does not consider these questions will be doomed to failure.

One of the more frequently stated objectives of any system must be to have a filtering mechanism between the user and the store of information so that only relevant information will be supplied. Licklider(14) gives this considerable attention, proposing a system which would allow the user to browse, eliminate items, modify, and narrow his search. Swanson(19), too, deals with the problem, suggesting selective dissemination to scientists, based on high selectivity and interpersonal communications. The small peer groups prevalent among scientists should be identified, and this information stored in the computer along with records for individuals as to what type of information they have used previously. Small centers might be operated, entirely without published information, but only to keep up with "who talks to whom" and to direct interested patrons to the most likely person or source for desired information. Williams(21) states that

published material is not the most important information source right now and will be even less so in the future. Communication between scientists is assuming increased importance. Freiser(8) echoes this opinion, stating that information is out of date when it is published and that libraries must provide non-published information by knowing where to direct the user.

Part of the problem here is the slowness with which information sees print. Preprints have solved some of this problem, but the "telepub network" goes one step further.(20)

As described by a library house organ, the network would work as follows: When a researcher has put his manuscript in final form (handwritten, with all diagrams and illustrations included), he would affix appropriate indexing words, and take it to a local "recording center" which would be interconnected with all other recording centers as a system, using closed circuit TV. His manuscript would be visually recorded on microtape, a computer would code it by author's names, institution and indexing terms. All other scientists would have access to it by dialing the appropriate index codes; the document would then be projected on a television screen. A print-out mechanism would provide hard copy if desired. The author envisions this as a profession-oriented service, presumably with each profession having its own system. Although seemingly "far out" the idea has considerable merit in terms of present plans for educational television networks spanning the nation.

2. Computer Potential:

Computers have undergone such rapid development, memories and speed having increased beyond anyone's expectations, that it is now possible to do virtually any library application on the computer. Software development has, of course, lagged far behind, but it is expected that within a period of one or two years, this gap will be closed. Diebold(5) predicts that a far larger percentage of computer expenditures will go for peripheral equipment in the future. The wide variety of peripherals for every conceivable purpose will increase computer capabilities considerably. He especially foresees graphic storage devices increasing rapidly. Information storage and retrieval will become an increasingly important part of systems, and one would suppose that hardware manufacturers would then become more responsive to library needs than they have been thus far. Man-machine interaction equipment will find wide acceptance and will be improved constantly. Disposable, cheap disk storage, reusable thermoplastic film as storage medium, PCMI film, a multiple font reader -- even dial-up facsimile are predicted. Sprague(17) tells of direct voice communication with the computer in natural language. The public utility concept for computer systems is mentioned again: a customer would insert a computer credit card into a terminal (e. g. a telephone set), which would identify him to the computer. He would then receive pre-recorded voice responses to questions, could receive an

image of a document on a screen or a printing device connected to the telephone.

A number of developments in terminal design should be mentioned here. DATASPEED has been described before (section D). There is a device which allows the user to connect it to a central computer anywhere as long as a telephone line is available:(18) The DATAPORT, designed by Carnegie Institute of Technology in Pittsburgh and manufactured by Electronic Systems, Inc., costs $2,800, and is transported in two suitcases weighing 37 lbs. and 39 lbs. respectively. One suitcase holds a typewriter-like device, while the other contains a control unit and a telephone interface unit. Unattended answerback service is part of the design.

An article in Steel(10) deals with the field of graphic display. It states that about a dozen firms are now engaged in manufacturing CRT's, while over forty make graphic transmission devices. More than one hundred firms are actively engaged in designing man-machine communications systems where a user may communicate directly with a computer in natural language and receive back understandable answers. The most versatile system is a CRT with light pen for modification of displayed information, a RAND tablet for handwritten input directly into the computer, a teleprinter for receiving printed information and a switchbox for buffering and switching between these devices. Presently only 5% of computer investment is in peri-

pheral equipment; this should grow to 60% within five years. The elimination of much internal reporting in paper form will be one of the more important byproducts of this conversion.

A two-color display system is being developed(9), and Feidelman (7) sees a bright future for character reading equipment, both in magnetic and optical scanners. Character recognition equipment(6) holds the greatest promise for libraries, since it it not limited to any particular typefont. Feidelman discusses specifically the VIDICON scanner, used in the UNIVAC Readatron, which appears to be a most practical device for reading large amounts of printed information.

With appropriate input devices, able to read all kinds of typefonts, and varied, flexible output equipment, as well as improved core storage and speed, computers offer the most promising answer to library intercommunications problems.

ii. Communications Links:

We have briefly discussed communications links and found that cost here is the major consideration for libraries. A number of technical developments in this area should be mentioned. Campbell(2) discusses the implication of communications satellites for libraries. He envisions computerization of information to be transmitted by libraries via satellites and points out cost advantages, provided the amount of information is great enough. A supra-national organization such as UNESCO would need to set international standards and provide the direction needed in a

multi-national effort. A network of national information systems must be established in each nation which would participate in this type of transmission so that all types of requested information could be transmitted, regardless of point of origin.

Laser transmission of data is discussed by Miller(15). After describing the four presently existing systems of data transmission (coaxial cable, microwave, wave guide, satellite, all of which operate on the multiplexing principle, transmitting messages simultaneously over the same pathway), he tells of efforts to pinpoint light waves so that they could be used for message transmission. After pointing up some of the rather formidable technical problems which have stood in the way of achieving this, he finds that several of them have been solved and others are near solution.

The technique of holography holds much promise for character reading in the future.(12) A hologram will be able to hold and discriminate between all numerals and letters of the alphabet, each with 30 variants, and may then be used to recognize a variety of typed or written information. Although far from being perfected, this area of research should be closely watched for future developments.

4. Summary:

We have considered a number of essential factors which must be present in any electronic interlibrary communications network. The user must receive first consideration; we know

something about his habits now and need to learn a great deal more. It may well be that the role of the library must change drastically to reflect the possibility of having the user on-line to the information store. Will the library be the filtering mechanism which would eliminate "noise on the channel" for him? Would it provide the switching mechanism by which he may contact his peer group for oral communication? Or will it be relegated, in such an on-line system, to the role of repository even more than it is now?

What will be the terminal device that is cheap and simple enough for anyone to use? Most likely the Touch-Phone, with its digital input capability, and a simple facsimile printer to produce hard copy if needed, or perhaps Picture-Phone which can project a small picture at the telephone set now, and could conceivably project print as well.(11)

Computer capability has increased to such an extent that it is now feasible to utilize it much more than ever before by libraries. Terminal devices of all kinds exist, which library personnel can use. Switching and buffering devices provide the interface between high-speed computers and low-speed data terminals.

But what of the printed information, the book, the journals? Will it ever become feasible to store entire works in the computer? This writer does not believe so; and microstorage seems to be the answer here. Several librarians agree; Clapp,(3, 4) Jones, (13) Samuel,(16) and others(1) envision miniaturization to

varied extents, and the further development of the photochromic microimage holds the greatest promise for the immediate future. Crystal storage of information is a possibility, although probably far away as yet.

Communications links are probably the major consideration in any network, because of their very high cost. Sharing links, subscribing to service offered as a public utility, and banding together in very large networks if direct links are desirable seem to offer the greatest hope here.

Much of the technology developed during very recent years has solved most or all of the problems standing in the way of forming interlibrary communications networks. The hardware exists; whether or not librarians are ready and willing to take advantage of it remains a question this paper does not presume to answer.

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